

REMARKS/ARGUMENTS

In the Office action dated April 15, 2005, the Examiner rejected claims 19-21, all of the claims then present in the Application under 35 U.S. C. § 103(a) as being unpatentable over U. S. Patent No. 6,028,362 of Omura, granted February 22, 2000.

In the Specification, no changes.

In the Claims, claims 19 and 21 have been amended; new claims 23 through 28 have been added.

The Invention

The invention is an integrated circuit which incorporates an ultra-thin layer of tungsten having a layer of copper formed thereon, wherein the tungsten layer facilitates the adhesion of copper to the remaining integrated circuit structures.

The Applied Art

U. S. Patent No. 6,028,362 to Omura, granted February 22, 2000, on an application having a priority date of May 12, 1997, describes use of a variety of metal in an integrated circuit, including, in some instances, an adhesive layer 50, formed of substances such as TiN, TiON, Ti, TiW and metal silicides; a conductive layer 52, which may be formed of W, Al, Al alloys, Ni or Cu; and a wiring material 56, such as Al, Al alloys, Cu and Cu alloys. Omura, however, places a conductive barrier layer 54 between conductive layer 52 and wiring layer 56, as shown in Figs. 8-14 and 26.

The Claims

Claim 19 has been amended to remove the thickness limitation of the metal barrier

layer and to add a period at the end of the claim. The claims stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Omura. Omura, however, places a conductive barrier layer 54 between a conductive layer 52 and a wiring layer 56. Further, conductive barrier layer 54 is, in reality formed of two layers of material, *i.e.*, a Ti layer and a sequentially formed TiN layer. Col. 10, lines 41-50. In the one example where Omura does not provide conductive barrier layer 54, see Fig. 22 and col. 16, lines 27 through col. 11, lines 67, conductive layer 52 is etched to expose adhesion layer 50, lying thereunder, to promote adhesion of the wiring material to the conductive layer. Claim 19 requires that a copper layer, a wiring material layer to use the language of the reference, be deposited on an ultra thin layer of tungsten, a conductive layer, which is formed on a metal barrier layer, an adhesion layer. Omura teaches that either (1) a conductive barrier layer be provided between the conductive layer and the copper layer, or (2) the conductive layer be partially etched to allow formation of a portion of the copper layer on the metal barrier layer.

Claim 19 also requires that the copper layer be deposited to a thickness sufficient to fill the vias and trenches of the structure. Omura teaches that the range is 500 nm to 1500 nm, col. 11, lines 3 to col. 12, line 55. This is considerably more than is required to fill the vias and trenches of the structure, and requires extensive CMP to produce the desired structure, because of the extremely thick layer of copper material deposited to form the copper layer - much more than is required to fill the vias and trenches in the structure. None of the teachings of the applied reference teach or suggest the structure taught and claimed by Applicants, and the claim is therefore allowable over the prior art of record.

Claim 20 is allowable with its allowable parent claim.

Claim 21 is allowable because the range of thicknesses required by Applicants is well with outside the range taught by the reference, which is 500 nm to 1500 nm, col. 11, lines 3 to col. 12, line 55, while Applicants require a range of between about 10 nm to 20 nm, which is all that is required to "...fill the vias and trenches in the structure...", which is another limitation of the claim, and which limitation is neither taught nor suggested by Omura. Omura further requires extensive CMP to produce the desired structure, because of the extremely thick layer of copper material deposited to form the copper layer - much more than is required to fill the vias and trenches in the structure. Claim 21 is therefor allowable over the applied art.

Claim 22 is allowable with its parent claim.

New claim 23 is a recitation of the limitations of allowable claim 19 with an added limitation, supported by the Specification and drawings, that copper layer 26 is deposited directly on the tungsten layer. As previously noted, the reference does not deposit copper directly on a tungsten layer, or, if so, also teaches that part of the tungsten layer must be removed to allow deposition of the copper on an adhesion layer underlying the tungsten layer. Claim 23 is allowable over the prior art of record.

Claims 24 and 26 are allowable with their allowable parent claims.

Claim 25 is allowable for the reasons set forth in connection with claim 21.

New claim 27 is a combination of claims 19, 21 and 22, and are allowable for the reasons set forth in connection with those claims.

New claim 28 is allowable with its allowable parent claim.

In light of the foregoing amendment and remarks, the Examiner is respectfully

requested to reconsider the rejections and objections stated in the Office action, and pass the application to allowance. If the Examiner has any questions regarding the amendment or remarks, the Examiner is invited to contact the undersigned.

Request for Extension of time in Which to Respond

Applicants hereby request an extension of time under 37 C.F.R. § 1.136. The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any over-payment to Account No. 22-0258. This response is accompanied by PTO Form 2038 Credit Card authorization in the amount of 120.00 is enclosed to pay the requisite extension fee.

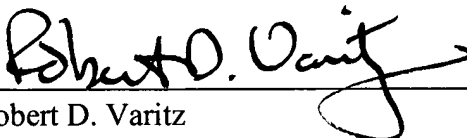
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Respectfully Submitted,

ROBERT D. VARITZ, P.C.

Registration No: 31436
Telephone: 503-720-1983
Facsimile: 503-233-7730


Robert D. Varitz
4915 S.E. 33d Place
Portland, Oregon 97202

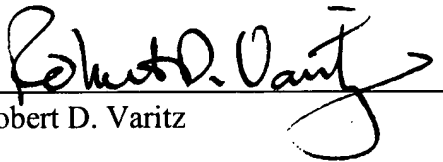
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I hereby certify that the attached RESPONSE TO OFFICE ACTION UNDER 37 C.F.R. § 1.111; Associate Power of Attorney, Change of Correspondence Address and a PTO Form 2038 credit card authorization in the amount of \$120.00 are being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 C.F.R. 1.10 on the date indicated above and is addressed to:

MS Amendment
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P.O. Box 1450
Alexandria, Virginia 22313-1450


Robert D. Varitz